June 16, 2010 – Staff Recommendation

SEASONAL APPLICATION OF WILD RICE SULFATE STANDARD

ISSUE:

Minnesota Rule 7050.0224 identifies a Class 4A water quality standard of 10 mg/L for sulfate, "…applicable to water used for production of wild rice during periods when the rice may be susceptible to damage by high sulfate levels". In order to effectively apply the standard, the period when wild rice may be susceptible to high sulfate levels needs to be determined.

OBJECTIVE:

This document focuses on the development of a MPCA staff recommendation for the time period of application of the wild rice standard for waters used for the production of wild rice potentially affected by the proposed PolyMet and Mesabi Nugget projects, namely portions of the Partridge and Embarrass Rivers, for which sufficient information is available to make a recommendation.

SUPPORTING INFORMATION:

- Minnesota Power Hearings (1975)
  - General consensus of the three wild rice experts testifying (Drs. Stewart, Grava and Moyle) was that if sulfate concentrations in water did affect wild rice, the most critical time would be during the spring of the year
  - Dr. Stewart testified that wild rice gets most of its nutrients from the water column from germination (late April to early May) to the aerial leaf stage with the most critical time being the early leaf stage (May)
  - Dr. Grava testified that high sulfate concentrations in the water at the time the seed germinates would be detrimental with this period of sensitivity extending until the aerial leaf is developed – he concludes that the overall period of sensitivity would be the months of April, May and June
  - Dr. Moyle testified that the period when high sulfate concentrations would be more critical than other times would be May and early June
  - Dr. Stewart testified that sulfate in the water column can be deposited or transferred to the sediment which can, under certain conditions (e.g. anaerobic or reducing conditions) create hydrogen sulfide which is known to be toxic to wild rice
  - Dr. Stewart further testified that creation of toxic levels of hydrogen sulfide is minimized in oxygenated water/sediment environments (which are unfavourable to the creation of hydrogen sulfide) or where sulfate is effectively removed from the system before it can be converted to hydrogen sulfide
  - Dr. Grava testified that hydrogen sulfide toxicity would be less likely in flowing water conditions than in stagnant water conditions – due generally to oxygenated sediment conditions preventing the formation of hydrogen sulfide and the moving water preventing accumulation of any hydrogen sulfide that may form
  - The Hearing Officer concluded, based on the testimony provided, that the more stringent discharge limits should be included in the permit for the critical months for wild rice (late April to mid June)

- Grava and Raisenen (1978)
  - Approximately 80% of nutrient (e.g., N, K, P) accumulation in the wild rice plant takes place between day 15 and day 90 following seed germination – up to 50% of that occurs between approximately day 55 and day 65.

Commented [DP1]: Assumption about condition of the sediment. What is known about the kind of sediments typically support wild rice beds?

- Oelke (1982)
    - Wild rice requires 106 – 130 days to mature in north central Minnesota, depending upon temperature during the growing season and variety. Flowering begins in late July and grain formation in August

- Rogosin (1986)
    - Seed germination occurs about the middle of May in northern areas when waters are free of ice. Stems begin to emerge in July

- Meeker (1993)
    - Germination of wild rice seed begins immediately at ice-out, which in his study area in northern Wisconsin can vary between mid April and early May depending on year and geographic location

- Lohse-Hanson Internal Memo (1988)
    - Memo prepared for Jim Strudell in NPDES permitting in response to questions raised by DNR Waters regarding the discharge from the Minntac tailings basin
    - Advised that the sulfate standard applies April 1 to June 30 and recommended no discharge of high sulfate basin water during this period
    - Advised that the sulfate standard does not apply July 1 to August 31 but recommended that a discharge be controlled so as not to adversely affect water levels
    - Advised that the sulfate standard does not apply September 1 to March 31 and stated that no information was available to suggest that a discharge was harmful at that time
    - These recommendations were based largely on recommendations from the Hearing Officer in the 1975 Minnesota Power hearing

- Doug Hall Letter to USX (2000)
    - Stated that the draft reissued permit for the Minntac tailings basin would likely include a discharge limit for sulfate of 10 mg/L effective April through September
    - The letter did not provide a rationale for the recommended effective period

- Strudell / White Internal Email (2004)
    - NPDES permitting requested of Environmental Outcomes confirmation of the effective period of April through September identified in the 2000 Doug Hall Letter to Minntac
    - Environmental Outcomes confirmed the recommendation of the entire growing season from April through September

- Minntac EIS – Wild Rice Technical Memo (2004)
    - By referencing the 2000 Doug Hall letter, the EIS stated that "the MPCA considers the 10 mg/L sulfate standard applicable to industrial discharges between the months of April and September"
    - Identified that this period "brackets the critical germination, boot stages and emergence stages of wild rice" (Note that these critical plant stages are completed well before September, the end of the identified period)
    - Reviewed various research data on higher sulfate levels and from this concluded that "it is reasonable to assume that "appropriate' sulfate levels for wild rice growth are bracketed within a range of 10-250 mg/L
    - Did not include sulfate as a 'baseline criteria for assessing impacts to wild rice (instead focused on water level, alkalinity, pH, hardness, heavy metals, etc.)

- MPCA Staff Communication with Dr. John Pastor (UMD) (2010)
    - Approximately 60 – 65 percent of the plant's nitrogen nutrient is taken up before it enters the reproductive growth phase. Then there is a secondary uptake "burst" from the sediments right before seed production. Also referenced internal translocation of nitrogen from parts of the plant into the developing grain.

SUMMARY

There appears to be an overall consensus from experts that the primary period of both nutrient uptake from the water column and susceptibility of the wild rice plant to high sulfate levels is from seed germination to leaf emergence with additional information suggesting a secondary period when the seed is developed in mid to late August. Assuming germination takes place at ice-out (which is generally mid April to mid May in the northern half of the state) and leaf emergence takes place by early July, it seems reasonable to determine that the main period of susceptibility extends primarily from mid April to mid July with a secondary period in August. Furthermore, the Partridge and Embarrass Rivers do not appear to have the morphology or hydrology characteristics that are conducive to hydrogen sulfide toxicity towards wild rice.

MPCA STAFF RECOMMENDATION

To be conservative, and to take into account variability associated with annual climatic variations, geographic locations and individual stand variability the MPCA staff recommendation is that the 10 mg/L sulfate standard is applicable for portions of the Partridge and Embarrass Rivers used for the production of wild rice from April 1 through August 31.

Commented [DP2]: Is this guidance implemented by imposing limits and conditions on dischargers to ensure that the 10 mg/L criterion is met from and including April 1

This recommendation is based on information currently available. MPCA staff will consider additional information that may become available in the future, whether from project proposers or from other interested/affected parties, and reserves the right to modify the staff recommendation accordingly.